

Germ Plasm Evaluation Program

Progress Report No. 9

Roman L. Hruska
U.S. Meat Animal Research Center

In cooperation with
Kansas State University
and the University of Nebraska

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The cattle Germ Plasm Evaluation Program at the Roman L. Hruska U.S. Meat Animal Research Center is designed to characterize different biological types represented by breeds varying widely in characteristics such as milk production, growth, mature size, and carcass composition. A major objective is to characterize breeds representing different biological types in different feed environments and production situations for the full spectrum of biological traits relating to economic beef production.

A coordinated research effort is employed involving scientists from the disciplines of animal breeding, reproductive physiology, nutrition, meats, and management systems. The program was initiated in 1969. Progress reports have been published annually summarizing current results from each cycle and phase of the program for traits of principal economic importance to the beef cattle industry.

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ROMAN L. HRUSKA U.S. MEAT ANIMAL RESEARCH CENTER

CATTLE GERM PLASM EVALUATION PROGRAM¹

PROGRESS REPORT NO. 9

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This report provides reproduction and maternal performance data for cows in each cycle and phase of the Germ Plasm Evaluation Program.

The cattle Germ Plasm Evaluation Program has been conducted in three cycles. Cycle I involved breeding Hereford, Angus, Jersey, South Devon, Limousin, Simmental, and Charolais bulls by artificial insemination (AI) to Hereford and Angus cows to produce three calf crops (Cycle I, Phase 2) in the spring of 1970, 1971 and 1972.

Cycle II, initiated with the 1972 breeding season, involved the Hereford and Angus cows used in the first cycle. These cows were bred by AI to Hereford, Angus, Red Poll, Brown Swiss, Gelbvieh, Maine Anjou, and Chianina sires to produce two calf crops (Cycle II, Phase 2) in the spring of 1973 and 1974. In addition, in Cycle II, Phase 2, Red Poll and Brown Swiss cows were added to the program and mated to Hereford, Angus, Red Poll, and Brown Swiss sires in a four-breed diallel crossbreeding experiment.

Cycle III was initiated during the 1974 breeding season. In Cycle III, the Hereford and Angus cows used to initiate Cycles I and II were mated by AI to Hereford, Angus, Pinzgauer, Tarentaise, Brahman, and Sahiwal sires to produce two calf crops (Cycle III, Phase 2) in the spring of 1975 and 1976.

Fifteen of the Hereford and 16 of the Angus sires used in Cycle I were also used in Cycle II and Cycle III to insure a stable control population of Hereford and Angus reciprocal crosses that are used as a basis for comparison between different cycles and phases of the program. Within each cycle of sire breeds, foundation cows (Hereford and Angus, in Cycles I, II, and III, plus Red Poll and Brown Swiss in Cycle II) are referred to as Phase 1. Their calves are called Phase 2, and the calves from Phase 2 cows are designated Phase 3. Specific mating plans for each cycle and phase of the program are provided in the appendix.

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Previous progress reports have presented complete data for Cycles I, II, and III and are available by request. Progress Report No. 1 (ARS-NC-13, 1974) included birth and weaning traits of Cycle I, Phase 2, calves and postweaning growth, feed efficiency, and carcass and meat traits of the steers. Progress Report No. 2 (ARS-NC-22, 1975) included the preweaning traits for both calf crops in Cycle II, phase 2. Progress Report No. 3 (ARS-NC-41, 1976) presented a complete summary and discussion of Cycle I, Phase 2, results from birth through slaughter for steers and from birth through puberty for the heifers. Progress Report No. 4 (ARS-NC-48, 1976) included preweaning and postweaning information for Cycle I, Phase 3, calves, and postweaning steer data for the 1974 calf crop and postweaning heifer data for both calf crops of Cycle II, Phase 2, calves. Progress Report No. 5 included complete results for birth and weaning traits on Cycle III, Phase 2, calves. Progress Report No. 6 (ARS-NC-2, 1978) included postweaning growth, and carcass data of steers and growth, puberty, and conception data of heifers in Cycle II, Phase 3 and Cycle III, Phase 2.

General releases of information on individual sires are not made because erroneous conclusions may be drawn from the ranking of individual sires with the relatively small number of progeny per sire in this program. The objective of the program is to characterize breeds as representatives of different biological types. To do this effectively, a large sample of sires of each breed is necessary. Thus, the number of progeny per sire is generally small. A relatively large number of progeny per sire is required for a high level of accuracy in ranking individual sires on their breeding value for most economic traits.

TRAITS MEASURED

Calving Difficulty. Calving difficulty scores were assigned to each calf at birth on the basis of the following system:

Score

- | | |
|-------------------------|---|
| 1 No difficulty | - Calves unassisted. |
| 2 Little difficulty | - Assistance given by hand, but no jack or puller used; assistance actually may not have been required. |
| 3 Moderate difficulty | - Assistance given with jack or calf-puller; some difficulty was encountered even with the puller being used. |
| 4 Major difficulty | - Calf jack used and major difficulty encountered usually 30 min or more required to deliver calf. |
| 5 Caesarean birth | - Performed after determination made that calf could not be delivered with a calf-puller. |
| 6 Abnormal presentation | - Assistance given: posterior, head back, leg back, and so forth. |

For the summaries of calving difficulty presented in his report, scores of 1 and 2 were combined and are designated no difficulty and scores of 3 and 4 were combined and are designated calf-puller.

Calf Crop. Calf crop percentages reflect the percentage of cows giving birth to or weaning a calf relative to all cows alive at calving time. Since cows were removed from the experiment only for serious injury, for being open 2 successive years or by death, percentage calf crop relative to all cows calving is virtually the same as percentage calf crop relative to all cows exposed to breeding.

Calf Mortality. Calf mortality is expressed as the percentage of all calves born that died early (within 72 hr of birth) or late (from 72 hr after birth until weaning) in the period from birth to weaning.

Calf Weights. Calf birth weights and 200-day weights reported are adjusted to a steer basis by adjustment factors calculated from the data and shown in the table footnotes. The 200-day weights were computed as ((actual weaning weight - birth weight)/weaning age) X 200 + birth weight.

Postpartum Interval. Postpartum interval, the number of days from calving to first estrus, is reported for certain groups in which it was recorded.

Percent Pregnant. Percent pregnant is the number palpated as pregnant divided by the number palpated (X 100) in the fall about 3 months after the breeding season. The data reported for percent pregnant only includes cows that calved prior to the breeding season.

Cow Weights and Hip Heights. Cow weights and hip heights reported were obtained on the cows in the fall at weaning time.

CYCLE I, PHASE 2

Foundation Cows. The foundation Hereford and Angus cows used in the program were purchased as calves at weaning from commercial producers in Nebraska. The cows were 2 through 5 years of age, 2 through 6 years of age, and 3 through 7 years of age at calving in 1970, 1971, and 1972, respectively.

Sires. In Cycle I, 32 Hereford, 35 Angus, 33 Jersey, 28 South Devon, 20 Limousin, 28 Simmental, and 26 Charolais bulls were used during the 1969, 1970, and 1971 breeding seasons. The Hereford and Angus bulls used in this program were sampled from bulls that had been selected on individual performance information, which was the basis for entering into the progeny testing programs of commercial AI organizations. The Jersey bulls were selected at random from two commercial AI organizations, and the South Devon bulls were sampled from an importation made in 1969 by a commercial organization. Simmental, Limousin, and Charolais bulls were sampled from bulls available from commercial AI organizations and from the Canada Department of Agriculture for the Simmental and Limousin.

For a cooperative study with the Canada Department of Agriculture, Hereford-Angus, Jersey-Angus, Simmental-Angus, and Charolais, Angus heifers were randomly selected at weaning time and shipped, 4 to 8 weeks after weaning, to the Research Station, Lethbridge, Alberta. There were 12 heifers per breed group in 1970 and 10 heifers per breed group in 1971 and 1972. These females and their offspring were individually fed to evaluate efficiency of production.

Matings. Cycle I, Phase 2, yearling heifers were mated to Hereford, Angus, Brahman, Devon, and Holstein bulls during a 45- to 46-day AI season and to Hereford and Angus bulls for a 21- to 24-day cleanup period in 1971, 1972, and 1973 (appendix table 3). As 2-year-old cows, they were mated to Hereford, Angus, Chianina, Gelbvieh and Maine Anjou bulls for a 42- to 45-day AI season and to Hereford and Angus bulls during a 22-day cleanup in 1972, 1973, and 1974. As 3-year-olds and at subsequent ages through 8 years of age, the cows were mated by natural service to Brown Swiss (predominantly European) bulls.

2-Year-Old Cows. Calving difficulty, calf mortality, calf birth weight and 200-day weight of progeny out of Cycle I, Phase 2 cows as 2-year-olds are presented in table 1. These data were analyzed by least-squares procedures for unequal subclass numbers using a model that included the effects of breed of cow's sire, breed of cow's dam, breed of calf's sire, year, sex, and most two-way interactions, with birth date as a covariate. Unweighted year-breed group means are presented in table 2 for calf birth date, calf crop percentage, postpartum interval, AI percentage, and pregnancy rate of the Cycle I, Phase 2 females as 2-year-olds.

3-Year-Old Cows. Calving difficulty, calf crop percentage, calf mortality, calf birth weight, and 200-day weight of progeny out of Cycle I, Phase 3 cows as 3-year-olds are provided in table 3. Calving date, postpartum interval, percentage pregnant, cow weight, and hip height for 3-year-olds are presented in table 4. Analytical procedures were the same as those used for 2-year-olds.

4-, 5-, 6-, 7-, and 8-Year-Old Cows. Summaries of calving difficulty, calf crop percentage, calf mortality, calf birth weight, and 200-day weight are presented in table 5 for Cycle I, Phase 2 cows calving at 4-, 5-, 6-, 7-, and 8-years of age. Calving date and rebreeding performance at 4 through 8 years of age and cow weight and hip height at 7 and 8 years of age are provided in table 6. Calving difficulty, calf mortality, calf birth weight, and 200-day weight were analyzed by least-squares procedures for unequal subclass numbers using a model that included the effects of breed of cow's sire, breed of cow's dam, cow age-year, sex, breed of cows sire-breed of cow's dam interaction, and breed of cow's dam-sex interaction. Calf crop percentage, pregnancy rate, cow weights, and heights were analyzed with a similar least-squares procedure except that sex and the two-way interaction with sex were not included in the model.

Discussion

Results on production of the F_1 females (as 2- through 8-year-olds) are summarized for Cycle I, Phase 2 females in table 7. Results presented in table 7 are adjusted for differences in sire breed of calf, for age of dam,

and year, and to a steer basis. Jersey cross females experienced less calving difficulty than other breed groups in Cycle I, especially as 2-year-olds (table 1). Differences in calving difficulty of F₁ cows were associated with birth weight of their calves. The relatively heavy weaning weights of calves from Simmental and Jersey cross dams in Cycle I reflect their greater milk production. Jersey cross dams produced more milk but calves with Simmental and Charolais cross dams were heavier at weaning than calves with Jersey cross dams because of greater growth rate transmitted by Simmental and Charolais cross dams. Calf weight at 200 days per F₁ cow exposed to breeding among the breed groups included in Cycle I had a range of 9%, i.e., 100% for Limousin and Hereford-Angus crosses to 109% for Simmental crosses.

TABLE 1. ROMAN L. HRUSKA U.S. MEAT ANIMAL RESEARCH CENTER GERM PLASM EVALUATION PROGRAM
CALVING DIFFICULTY, CALF CROP PERCENTAGE, CALF MORTALITY, BIRTH WEIGHT, WEANING WEIGHT,
AND WEANING WEIGHT RATIO OF CALVES FROM 2-YEAR OLD COWS^a
CYCLE I, PHASE 2 - COWS BORN 1970-71-72

Breed of cow		Number calves born	Type of parturition, %				Calf crop, % ^c		Calf mortality, % ^d		Calf weight, lb ^e		
Sire	Dam		No diff. ^b	Calf puller	C- section	Abn. pre- sentation	Born	Weaned	Early	Late	Birth	200- day wt	200-day wt ratio ^f
Angus	Hereford	48	57.6	34.4	3.9	4.1	88.1	78.0	4.7	6.8	68.9	383	103.5
Hereford	Angus	50	62.4	27.3	8.5	1.8	87.7	76.2	7.9	5.2	67.8	357	96.5
	Average	98	60.0	30.9	6.1	3.0	87.9	77.1	6.3	6.0	68.4	370	100.0
Jersey	Hereford	51	86.3	11.8	.0	2.7	86.9	84.2	3.1	.0	66.9	412	111.4
	Angus	46	73.1	19.8	.0	7.4	83.9	74.3	10.1	1.3	63.8	405	109.5
	Average	97	79.7	15.8	.0	5.0	85.4	79.3	6.6	.6	65.3	409	110.5
South Devon	Hereford	50	47.7	43.7	5.1	3.5	83.9	78.7	.3	6.0	75.9	374	101.1
	Angus	46	50.0	43.3	3.5	3.1	82.5	71.5	10.7	2.6	76.7	392	105.9
	Average	96	48.9	43.5	4.3	3.3	83.2	75.0	5.5	4.3	76.3	383	103.5
Limousin	Hereford	53	66.7	19.6	.6	13.0	72.0	53.0	10.5	15.9	69.2	377	101.9
	Angus	65	63.3	30.4	1.7	4.6	90.9	79.3	9.1	3.8	71.3	385	104.1
	Average	118	65.0	25.0	1.2	8.8	81.5	66.1	9.8	9.8	70.3	381	103.0
Simmental	Hereford	69	54.4	37.3	7.5	.8	82.2	79.5	1.0	2.3	76.2	414	111.9
	Angus	55	53.4	31.2	9.3	6.0	83.8	75.1	7.0	3.4	75.7	412	111.4
	Average	124	53.9	34.3	8.4	3.4	83.0	77.3	4.0	2.9	75.9	413	111.6
Charolais	Hereford	60	57.9	29.8	6.9	5.4	81.8	72.3	4.2	7.4	75.5	395	106.8
	Angus	42	54.3	36.8	2.6	6.3	78.2	65.5	10.8	5.4	76.3	393	106.2
	Average	102	56.1	33.3	4.7	5.9	80.0	68.9	7.5	6.4	75.9	394	106.5
Average all sire breeds	Hereford	331	61.8	29.4	3.9	4.9	82.5	74.0	4.0	6.4	72.1	393	106.2
	Angus	304	59.4	31.5	4.2	4.9	84.5	73.6	9.3	3.6	71.9	391	105.7
	Average	635	60.6	30.5	4.0	4.9	83.5	73.8	6.6	5.0	72.0	392	105.9

^a Calves from these cows were sired by Hereford, Angus, Devon, Holstein, and Brahman bulls (appendix table 3).

^b No assistance or minor hand assistance.

^c Of cows alive at calving; cows removed from experiment only for serious injury or by death and not for being open.

^d Early mortality is within 24 hr of birth; late is from 24 hr after birth until weaning.

^e Adjusted to a steer basis. Least-squares adjustment factors for heifers were 4.8 lb for birth weight and 20 lb for 200-day weight.

^f Ratio computed relative to 370 lb average for Hereford and Angus sired dams.

TABLE 2. ROMAN L. HRUSKA U.S. MEAT ANIMAL RESEARCH CENTER GERM PLASM EVALUATION PROGRAM
CALVING DATE, REBREEDING PERFORMANCE, AND SIZE OF COWS CALVING AS 2-YEAR-OLDS
CYCLE I, PHASE 2 - COWS BORN 1970-71-72

Breed of cow		Number calving as 2-year-olds	Average calving date	Bred AI, % ^a	Postpartum interval, days ^b	Percent pregnant ^a	Cow weight, lb 2-1/2 years	Hip height, in 2-1/2 years ^c
Sire	Dam							
Angus Hereford	Hereford	48	March 24	83.9	83.6	89.3	872	47.0
	Angus	50	March 24	85.7	84.8	85.7	901	46.4
	Average	98	March 24	84.8	84.2	87.5	887	46.7
Jersey	Hereford	51	March 22	90.2	77.4	98.0	802	47.1
	Angus	46	March 22	91.5	78.2	89.4	791	47.2
	Average	97	March 22	90.8	77.8	93.7	796	47.1
South Devon	Hereford	50	March 27	78.8	83.2	80.8	926	49.2
	Angus	46	March 25	87.2	82.8	89.4	940	48.7
	Average	96	March 26	83.0	83.0	85.1	933	48.9
Limousin	Hereford	53	April 2	70.7	82.1	84.5	927	49.4
	Angus	65	March 27	78.3	82.6	75.4	922	48.9
	Average	118	March 30	74.5	82.4	79.9	925	49.1
Simmental	Hereford	69	March 24	75.7	88.8	81.0	958	49.8
	Angus	55	March 22	84.2	91.0	78.9	951	49.4
	Average	124	March 23	79.9	89.9	80.0	954	49.6
Charolais	Hereford	60	March 27	80.3	86.3	85.2	1000	49.7
	Angus	42	March 22	76.7	91.1	81.4	1029	49.1
	Average	102	March 25	78.5	88.7	83.3	1015	49.4
Average All Sire Breeds	Hereford	331	March 26	79.9	83.7	86.5	914	48.7
	Angus	304	March 24	83.9	85.3	83.4	922	48.3
	Average	635	March 25	81.9	84.5	84.9	918	48.5

^a Breeding period was 42 to 45 days by AI (appendix table 3) and 22 days by natural service (Hereford or Angus cleanup bulls). Percent pregnant = number palpated as pregnant ÷ number palpated, and only include cows that calved prior to breeding.

^b Interval from calving to first estrus.

^c Hip height measurements at 2-1/2 years of age available only on 1972 born cows.

TABLE 3. ROMAN L. HRUSKA U.S. MEAT ANIMAL RESEARCH CENTER GERM PLASM EVALUATION PROGRAM
CALVING DIFFICULTY, CALF CROP PERCENTAGE, CALF MORTALITY, BIRTH WEIGHT,
WEANING WEIGHT, AND WEANING WEIGHT RATIO OF CALVES FROM 3-YEAR-OLD COWS^a
CYCLE I, PHASE 2 - COWS BORN 1970-71-72

Breed of cow		Number calves born	Type of parturition, %				Calf crop, % ^c		Calf mortality, % ^d		Calf weight, lb ^e		
Sire	Dam		No diff. ^b	Calf puller	C-section	Abn. presentation	Born	Weaned	Early	Late	Birth	200-day wt	200-day wt ratio ^f
Angus	Hereford	56	71.5	16.8	1.9	9.7	84.8	74.2	8.1	4.4	83.6	429	102.1
Hereford	Angus	56	65.0	25.6	1.6	7.8	87.5	80.6	5.2	2.7	83.8	411	97.9
	Average	112	68.3	21.2	1.8	8.8	86.2	77.4	6.7	3.5	83.7	420	100.0
Jersey	Hereford	54	90.7	6.7	0.0	2.9	91.5	82.7	5.3	4.3	78.7	445	106.0
	Angus	46	78.8	14.2	0.1	7.0	88.5	83.3	5.1	0.7	76.5	444	105.7
	Average	100	84.8	10.5	0.0	4.9	90.0	83.1	5.2	2.5	77.6	444	105.7
South Devon	Hereford	50	65.5	23.0	0.3	11.2	83.3	75.4	3.8	5.7	89.0	438	104.3
	Angus	46	72.8	14.5	2.3	10.4	86.8	81.2	6.7	0.0	88.9	434	103.3
	Average	96	69.2	18.7	1.3	10.8	85.0	78.3	5.3	2.8	89.0	436	103.8
Limousin	Hereford	70	73.2	21.5	4.3	1.0	87.5	77.4	2.1	9.4	87.3	431	102.6
	Angus	54	80.9	17.4	0.9	0.8	72.0	64.3	3.6	7.1	87.4	429	102.1
	Average	124	77.0	19.5	2.6	0.9	79.8	70.9	2.8	8.3	87.4	430	102.4
Simmental	Hereford	71	64.7	24.8	8.0	2.5	81.6	73.3	4.9	5.3	91.0	468	111.4
	Angus	53	70.6	22.0	4.5	2.9	81.5	73.6	4.1	5.7	86.5	464	110.5
	Average	124	67.6	23.4	6.3	2.7	81.6	73.4	4.5	5.5	88.8	466	111.0
Charolais	Hereford	62	75.8	18.0	1.6	4.6	83.8	78.9	1.6	4.3	91.0	438	104.3
	Angus	46	65.3	22.0	4.0	8.8	85.2	78.3	3.3	4.8	90.5	438	104.3
	Average	108	70.6	20.0	2.8	6.7	84.5	78.6	2.4	4.5	90.8	438	104.3
Average all sire breeds	Hereford	363	73.6	18.5	2.6	5.3	85.4	76.9	4.3	5.6	86.8	442	105.2
	Angus	301	72.2	19.3	2.2	6.3	83.6	76.8	4.7	3.4	85.6	437	104.0
	Average	664	72.9	18.9	2.4	5.8	84.5	76.9	4.5	4.5	86.2	440	104.8

^a Calves from these cows were sired by Hereford, Angus, Gelbvieh, Maine Anjou, and Chianina bulls (appendix table 3).

^b No assistance or minor hand assistance.

^c Of cows alive at calving; cows removed from experiment only for serious injury, being open 2 consecutive years or by death.

^d Early mortality is within 72 hr of birth; late is from 72 hr after birth until weaning.

^e Adjusted to a steer basis. Least-squares adjustment factors for heifers were 6.7 lb for birth weight and 18 lb for 200-day weight.

^f Ratio computed relative to 420 lb average for Hereford and Angus sired dams.

TABLE 4. ROMAN L. HRUSKA U.S. MEAT ANIMAL RESEARCH CENTER GERM PLASM EVALUATION PROGRAM
CALVING DATE, REBREEDING PERFORMANCE, AND SIZE OF COWS CALVING AS 3-YEAR-OLDS
CYCLE I, PHASE 2 - COWS BORN 1970-71-72

Breed of cow		Number calving as 3-year-olds	Average calving date	Postpartum interval, days ^a	Percent pregnant ^b	Cow weight, lb 3-1/2 years	Hip height, in 3-1/2 years ^c
Sire	Dam						
Angus Hereford	Hereford	56	April 7	60.9	89.3	968	47.5
	Angus	56	April 8	63.9	94.6	999	47.6
	Average	112	April 8	62.4	92.0	983	47.5
Jersey	Hereford	54	March 31	64.4	98.1	858	47.7
	Angus	46	March 28	68.6	91.3	858	47.6
	Average	100	March 30	66.5	94.7	858	47.6
South Devon	Hereford	50	April 9	64.5	89.8	1035	49.9
	Angus	46	April 7	57.9	82.2	1003	49.2
	Average	96	April 8	61.2	86.0	1019	49.6
Limousin	Hereford	70	April 10	63.8	92.5	1024	50.2
	Angus	54	April 6	62.2	96.3	1017	49.4
	Average	124	April 8	63.0	94.4	1020	49.8
Simmental	Hereford	71	April 7	64.7	95.7	1047	50.3
	Angus	53	April 3	63.7	88.5	1034	49.7
	Average	124	April 5	64.2	92.1	1041	50.0
Charolais	Hereford	62	April 7	62.0	96.7	1100	50.2
	Angus	46	April 7	69.1	86.7	1099	49.5
	Average	108	April 7	65.6	91.7	1100	49.9
Average all sire breeds	Hereford	363	April 7	63.4	93.7	1005	49.3
	Angus	301	April 5	64.2	89.9	1002	48.8
	Average	664	April 6	63.8	91.8	1003	49.1

^a Interval from calving to first estrus.

^b Breeding period was 64 days by natural service to Brown Swiss bulls. Percent pregnant = number palpated as pregnant ÷ number palpated, and only includes cows that calved prior to breeding.

^c Hip height measurements at 3-1/2 years of age available only on 1971 and 1972 born cows.

TABLE 5. ROMAN L. HRUSKA U.S. MEAT ANIMAL RESEARCH CENTER GERM PLASM EVALUATION PROGRAM
CALVING DIFFICULTY, CALF CROP PERCENTAGE, CALF MORTALITY, BIRTH WEIGHT, WEANING WEIGHT,
AND WEANING WEIGHT RATIO OF CALVES FROM 4-, 5-, 6-, 7-, AND 8-YEAR-OLD COWS^a
CYCLE I, PHASE 2 - COWS BORN 1970-71-72

Breed of cow		Number calves born	Type of parturition, %				Calf crop, % ^c		Calf mortality, % ^d		Calf weight, lb ^e		
Sire	Dam		No diff. ^b	Calf puller	C- section	Abn. pre- sentation	Born	Weaned	Early	Late	Birth	200- day wt	200-day wt ratio ^f
Angus	Hereford	256	97.4	0.3	0.0	2.3	95.1	86.8	2.7	5.5	90.1	511	101.2
Hereford	Angus	272	95.5	3.0	0.4	1.2	95.7	89.6	4.4	1.5	91.1	499	98.8
	Average	528	96.4	1.7	0.2	1.7	95.4	88.2	3.6	3.5	90.6	505	100.0
Jersey	Hereford	241	98.4	0.8	0.0	0.8	96.2	91.0	3.8	1.7	84.6	523	103.6
	Angus	190	97.9	0.5	0.0	1.6	90.4	81.9	4.7	4.7	80.4	512	101.4
	Average	431	98.1	0.7	0.0	1.2	93.3	86.4	4.2	3.2	82.5	517	102.4
South Devon	Hereford	219	93.8	2.9	0.5	2.8	93.3	90.0	1.3	2.7	97.3	526	104.2
	Angus	192	94.0	2.4	0.0	3.6	93.0	89.4	2.5	1.1	92.0	521	103.2
	Average	411	93.9	2.7	0.2	3.2	93.1	89.7	1.9	1.9	94.7	523	103.6
Limousin	Hereford	302	96.2	2.0	0.0	1.7	93.6	87.4	4.9	1.9	94.2	519	102.8
	Angus	307	94.3	2.5	0.3	2.9	97.8	91.1	6.1	1.0	89.4	510	101.0
	Average	609	95.2	2.3	0.2	2.3	95.7	89.2	5.5	1.4	91.8	514	101.8
Simmental	Hereford	348	91.2	5.9	0.6	2.3	96.1	91.0	5.2	0.9	96.9	554	109.7
	Angus	276	93.6	3.6	0.0	2.9	92.8	84.9	5.8	1.8	93.6	550	108.9
	Average	624	92.4	4.7	0.3	2.6	94.5	88.0	5.5	1.4	95.3	552	109.3
Charolais	Hereford	290	91.5	4.1	1.0	3.4	95.3	85.8	6.8	3.8	96.7	536	106.1
	Angus	193	92.3	3.1	0.5	4.1	91.6	83.8	6.6	2.6	96.3	536	106.1
	Average	483	91.9	3.6	0.8	3.7	93.5	84.8	6.7	3.2	96.5	536	106.1
Average all sire breeds	Hereford	1656	94.8	2.7	0.4	2.2	94.9	88.7	4.1	2.8	93.3	528	104.6
	Angus	1430	94.5	2.5	0.2	2.7	93.6	86.8	5.0	2.1	90.5	521	103.2
	Average	3086	94.7	2.6	0.3	2.5	94.2	87.7	4.6	2.4	91.9	525	104.0

^a Calves from these cows were sired by Brown Swiss bulls (appendix table 3).

^b No assistance or minor hand assistance.

^c Of cows alive at calving; cows removed from experiment only for serious injury, being open two consecutive years or by death.

^d Early mortality is within 72 hr of birth; late is from 72 hr after birth until weaning.

^e Adjusted to a steer basis. Least-squares adjustment factors for heifers were 6.7 lb for birth weight and 34 lb for 200-day weight.

^f Ratio computed relative to 505 lb average for Hereford and Angus sired dams.

TABLE 6. ROMAN L. HRUSKA U.S. MEAT ANIMAL RESEARCH CENTER GERM PLASM EVALUATION PROGRAM
CALVING DATE AND REBREEDING PERFORMANCE AS 4-, 5-, 6-, 7-, AND 8-YEAR-OLD COWS
AND SIZE AS 7- AND 8-YEAR OLD COWS CYCLE I, PHASE 2 - COWS BORN 1970-71-72

Breed of cow		Number of cows		Average calving date ^a	Percent pregnant ^b	Cow weight, lb		Hip height, in	
Sire	Dam	7-yr olds	8-yr olds			7-1/2 years	8-1/2 years	7-1/2 years	8-1/2 years
Angus Hereford	Hereford	53	37	March 31	95.4	1219	1220	48.7	48.8
	Angus	59	42	April 4	94.9	1231	1224	48.6	48.8
	Average	112	79	April 2	95.2	1225	1222	48.6	48.8
Jersey	Hereford	50	45	March 29	97.5	1071	1070	48.7	48.8
	Angus	42	25	March 29	91.5	1067	1046	48.2	47.8
	Average	92	70	March 29	94.5	1069	1058	48.4	48.3
South Devon	Hereford	47	23	April 6	94.0	1277	1280	50.8	50.9
	Angus	41	32	April 1	93.6	1254	1244	50.4	50.4
	Average	88	55	April 3	93.8	1266	1262	50.6	50.6
Limousin	Hereford	70	36	April 4	95.1	1240	1241	50.9	50.7
	Angus	67	41	March 31	96.6	1230	1231	50.2	50.0
	Average	137	77	April 2	95.9	1235	1236	50.6	50.3
Simmental	Hereford	77	46	April 5	95.2	1273	1281	51.5	51.4
	Angus	62	45	April 1	94.4	1291	1254	50.8	50.7
	Average	139	91	April 3	94.8	1282	1268	51.1	51.0
Charolais	Hereford	63	41	April 4	96.0	1367	1352	51.3	51.2
	Angus	44	25	April 4	94.1	1347	1354	51.0	51.0
	Average	107	66	April 4	95.1	1357	1353	51.2	51.1
Average all sire breeds	Hereford	360	228	April 3	95.5	1241	1241	50.3	50.3
	Angus	315	210	April 1	94.2	1237	1226	49.9	49.8
	Average	675	438	April 2	94.9	1239	1233	50.1	50.0

^a Includes cows calving at 4-, 5-, 6-, 7- and 8-years of age.

^b Breeding period was 63 days by natural service to Brown Swiss bulls (appendix table 3). Percent pregnant = number palpated as pregnant ÷ number palpated, and only includes cows that calved prior to breeding.

TABLE 7. ROMAN L. HRUSKA U.S. MEAT ANIMAL RESEARCH CENTER GERM PLASM EVALUATION PROGRAM.
BREED GROUP MEANS FOR REPRODUCTION AND MATERNAL PERFORMANCE OF F₁ COWS AT 2 THROUGH 8 YEARS OF AGE
CYCLE I, PHASE 2 - COWS BORN 1970-71-72

Breed group ^a	Number births	Calving diffi- culty ^b %	Calf crop		Birth weight lb	Milk prod ^c lb	200-day weight			
			Born %	Weaned %			Per calf weaned lb	Ratio ^d %	Per cow exposed lb	Ratio ^d %
Hereford-Angus-X	738	10	93	85	86	6.6	472	100	401	100
Jersey-X	628	4	92	85	79	9.7	490	104	415	104
Limousin-X	851	9	91	83	88	6.0	481	102	400	100
South Devon-X	603	12	90	86	91	7.0	489	104	420	105
Simmental-X	872	14	91	84	91	8.8	518	110	436	109
Charolais-X	693	12	90	81	93	6.0	500	106	408	102

^a Breed groups are identified by sire breed. An X denotes crosses out of Hereford and Angus dams.

^b Includes calves requiring calf puller or C-section.

^c Average of three 12-hour milk production measures on a sample of 18 cows per breed group at 3 and 4 years of age.

^d Ratio relative to Hereford-Angus crosses.

CYCLE I, PHASE 3

Matings. The mating plans to produce Cycle I, Phase 3, calves are shown in appendix table 3. As yearling heifers, the Cycle I, Phase 2, females were bred AI to 16 Hereford, 25 Angus, 14 Brahman, 12 Devon, and 13 Holstein sires for 45 to 46 days followed by a 21- to 24-day cleanup mating period to Hereford and Angus sires to produce their first calf crops as 2-year-olds in the spring of 1972, 1973, and 1974. Birth, survival, preweaning growth, and postweaning steer and heifer data for the Cycle I, phase 3, calves were reported previously (ARS-NC-48, Progress Report No. 4, 1976). The females produced in Cycle I, Phase 3, were retained to evaluate their maternal and reproductive performance when mated naturally to Red Poll bulls.

2-Year-Olds. Data on calving difficulty, calf mortality, and preweaning growth and on cow rebreeding performance and size as 2-year-olds are reported in tables 8 and 9 by breed of the cow's sire. Calving difficulty, calf mortality, calf birth weight and preweaning growth were analyzed by least-squares procedures for unequal subclass numbers using a model that included the effects of breed of cow's sire, breed of cow's dam, cow age-year, sex, breed of cow's sire-breed of cow's dam interaction, and breed of cow's dam-sex interaction. Unweighted means are presented for calf crop percentage and pregnancy rate. Cow weights (tables 7 and 8) are least-squares means from an analytical model similar to the one used for calf traits, except that sex was omitted.

2-, 3-, 4-, and 5-Year-Olds. Calving difficulty, calf crop percentage, and progeny birth and 200-day weights are shown in table 10 for Cycle I, Phase 3, cows according to the breed of the cow's sire. Calving date, pregnancy rate, and cow weights are shown in table 11. Calving difficulty, calf mortality, calf birth weight and preweaning growth were analyzed by least-squares procedures for unequal subclass numbers using a model that included the effects of breed of cow's grandsire, breed of cow's granddam, breed of cow's sire, year-age, sex, and two-way interactions. Calf crop percentage, pregnancy rate, and cow weights are least-squares means from an analytical model similar to the one used for calf traits, except that sex was omitted.

Discussion

Results on production of the 3-way cross females (as 2- through 5-year-olds) from Cycle I, Phase 3 of the program are summarized in table 12. Calving difficulty was less in Brahman cross and Devon cross females than Hereford-Angus cross and Holstein cross females. Calves out of Brahman cross females were significantly lighter at birth than calves out of all other crosses. Calves out of Holstein cross females were significantly heavier at birth than calves out of Hereford-Angus cross and Devon cross females; however, Holstein crosses did not differ significantly from Hereford-Angus crosses in calving difficulty. Differences between breed groups for percentage calf crop born and percentage calf crop weaned were not significant ($P>.05$). Weaning weight per calf weaned and per cow exposed to breeding was significantly higher for progeny of Holstein cross and Brahman cross females than for progeny of Hereford-Angus cross and Devon cross females.

TABLE 8. ROMAN L. HRUSKA U.S. MEAT ANIMAL RESEARCH CENTER GERM PLASM EVALUATION PROGRAM
CALVING DIFFICULTY, CALF MORTALITY, BIRTH WEIGHT, WEANING WEIGHT,
AND WEANING WEIGHT RATIO OF CALVES FROM 2-YEAR-OLD COWS^a
CYCLE I, PHASE 3 - COWS BORN 1972-73-74

Breed of cow		Number calves born	Type of parturition, %				Calf mortality, % ^d		Calf weight, lb ^e		
Sire	Dam ^b		No diff. ^c	Calf puller	C- section	Abn. pre- sentation	Early	Late	Birth	200- day wt	200-day wt ratio ^f
Angus Hereford	Hereford-X	44	64.8	30.2	3.3	1.7	12.6	0.0	73.7	397	99.0
	Angus-X	46	41.8	48.5	8.5	1.2	5.0	1.5	75.1	404	100.7
	Average	90	53.3	39.3	5.9	1.5	8.8	0.0	74.4	401	100.0
Brahman	Hereford-X	26	93.0	8.8	0.0	0.1	1.9	19.3	75.0	459	114.5
	Angus-X	17	86.6	12.2	3.6	0.0	4.6	3.0	69.7	473	118.0
	Average	43	89.9	10.5	0.8	0.0	3.2	11.1	72.3	466	116.2
Devon	Hereford-X	29	63.6	33.7	3.5	0.0	7.8	0.8	76.1	406	101.2
	Angus-X	28	54.2	42.5	0.0	3.8	28.0	4.1	72.9	411	102.5
	Average	57	58.9	38.1	1.5	1.5	17.9	2.5	74.5	408	101.7
Holstein	Hereford-X	25	70.2	25.0	3.4	1.4	0.1	5.3	84.7	475	118.5
	Angus-X	20	43.7	57.7	0.0	0.0	6.8	6.4	86.0	470	117.2
	Average	45	56.9	41.4	1.6	0.1	3.4	5.8	85.3	472	117.7
Average all sire breeds	Hereford-X	124	72.9	24.4	2.1	0.6	5.6	6.0	77.4	434	108.2
	Angus-X	111	56.6	40.2	2.9	0.3	11.1	3.7	75.9	439	109.5
	Average	235	64.8	32.3	2.5	0.5	8.3	4.9	76.6	437	109.0

^a These cows were bred to Red Poll bulls.

^b Hereford-X denotes Hereford crosses and Angus-X denotes Angus crosses. Dams of these cows were sired by Hereford, Angus, Jersey, South Devon, Limousin, Simmental, and Charolais bulls.

^c No assistance or minor hand assistance.

^d Early mortality is within 72 hr of birth; late is from 72 hr after birth until weaning.

^e Adjusted to a steer basis. Least squares adjustment factors for heifers were 4.3 lb for birth weight and 29 lb for 200-day weight.

^f Ratio computed relative to 401 lb average for Hereford and Angus sired dams.

TABLE 9. ROMAN L. HRUSKA U.S. MEAT ANIMAL RESEARCH CENTER GERM PLASM EVALUATION PROGRAM
CALF CROP PERCENTAGE, CALVING DATE, REBREEDING PERFORMANCE AND SIZE OF COWS CALVING AS 2-YEAR-OLDS
CYCLE I, PHASE 3 - COWS BORN 1972-73-74

Breed of cow		Number calving as 2-year-olds	Calf crop, % ^b		Average calving date	Percent pregnant ^c	Cow weight, lb 2-1/2 years
Sire	Dam ^a		Born	Weaned			
Angus Hereford	Hereford-X	44	89.8	73.5	March 30	86.4	873
	Angus-X	46	87.0	79.6	March 29	91.5	870
	Average	90	88.4	76.7	March 29	89.0	871
Brahman	Hereford-X	26	83.9	70.1	April 14	92.3	961
	Angus-X	17	100.0	88.2	April 2	100.0	940
	Average	43	89.6	77.1	April 8	95.4	950
Devon	Hereford-X	29	88.2	76.5	April 3	93.3	882
	Angus-X	28	87.9	63.6	March 27	96.6	907
	Average	57	88.1	70.2	March 30	94.9	895
Holstein	Hereford-X	25	100.0	92.9	March 27	92.9	949
	Angus-X	20	90.9	72.7	April 1	95.0	940
	Average	45	96.0	84.0	March 30	93.8	945
Average all sire breeds	Hereford-X	124	90.1	77.5	April 3	90.6	916
	Angus-X	111	89.7	75.4	March 30	94.7	914
	Average	235	89.9	76.5	April 1	92.5	915

^a Hereford-X denotes Hereford crosses and Angus-X denotes Angus crosses. Dams of these cows were sired by Hereford, Angus, Jersey, South Devon, Limousin, Simmental, and Charolais bulls.

^b Of heifers exposed to breeding and alive at fall palpation the previous year.

^c Breeding period averaged 56 days by natural service to Red Poll bulls. Percent pregnant = number palpated as pregnant ÷ number palpated, and only include cows that calved prior to breeding.

TABLE 10. ROMAN L. HRUSKA U.S. MEAT ANIMAL RESEARCH CENTER GERM PLASM EVALUATION PROGRAM
CALVING DIFFICULTY, CALF MORTALITY, BIRTH WEIGHT, WEANING WEIGHT, AND WEANING
WEIGHT RATIO OF CALVES FROM 2-, 3-, 4-, AND 5-YEAR-OLD COWS BY BREED OF SIRE^a
CYCLE I, PHASE 3 - COWS BORN 1972-73-74

Breed of cow		Number calves born	Type of parturition, %				Calf mortality, % ^d		Calf weight, lb ^e		
Sire	Dam ^b		No diff. ^c	Calf puller	C- section	Abn. pre- sentation	Early	Late	Birth	200- day wt ^e	200-day wt ratio ^f
Angus	Hereford-X	116	84.9	11.9	2.6	0.7	11.5	0.8	79.5	432	101.2
Hereford	Angus-X	127	73.6	20.8	4.9	0.7	3.6	1.5	79.6	423	99.1
	Average	243	79.2	16.3	3.7	0.7	7.5	1.1	79.6	427	100.0
Brahman	Hereford-X	72	94.2	4.3	0.0	2.3	4.0	8.0	75.3	474	111.0
	Angus-X	51	94.9	3.7	1.9	0.0	2.8	3.6	75.8	484	113.4
	Average	123	94.6	4.0	0.6	0.9	3.4	5.8	75.6	479	112.2
Devon	Hereford-X	89	85.5	11.9	2.1	0.5	1.8	0.0	81.0	428	100.2
	Angus-X	83	81.2	17.7	0.0	1.7	15.3	2.5	78.8	422	98.8
	Average	172	83.3	14.8	0.7	1.1	8.5	1.2	79.9	425	99.5
Holstein	Hereford-X	64	88.0	10.2	1.5	0.3	2.9	4.3	85.5	492	115.2
	Angus-X	49	79.4	20.0	0.3	0.2	9.0	0.8	86.7	487	114.1
	Average	113	83.7	15.1	0.9	0.3	6.0	2.6	86.1	490	114.8
Average all sire breeds	Hereford-X	341	88.1	9.6	1.3	1.0	5.1	3.3	80.3	456	106.8
	Angus-X	310	82.3	15.5	1.6	0.5	7.7	2.1	80.2	454	106.3
	Average	651	85.2	12.6	1.5	0.8	6.4	2.7	80.3	455	106.6

^a These cows were bred to Red Poll bulls.

^b Hereford-X denotes Hereford crosses and Angus-X denotes Angus crosses. Dams of these cows were sired by Hereford, Angus, Jersey, South Devon, Limousin, Simmental, and Charolais bulls.

^c No assistance or minor hand assistance.

^d Early mortality is within 72 hr of birth; late is from 72 hr after birth until weaning.

^e Adjusted to a steer basis. Least-squares adjustment factors for heifers were 3.3 lb for birth weight and 24 lb for 200-day weight.

^f Ratio computed relative to 427 lb average for Hereford and Angus sired dams.

TABLE 11. ROMAN L. HRUSKA U.S. MEAT ANIMAL RESEARCH CENTER GERM PLASM EVALUATION PROGRAM
CALF CROP PERCENTAGE, CALVING DATE, REBREEDING PERFORMANCE, AND SIZE OF COWS CALVING AS
2-, 3-, 4-, AND 5-YEAR-OLD COWS BY BREED OF SIRE
CYCLE I, PHASE 3 - COWS BORN 1972-73-74

Breed of cow		Number calving as				Calf crop, % ^b		Average calving date	Percent pregnant ^c	Cow weight, lb			
Sire	Dam ^a	2-yr olds	3-yr olds	4-yr olds	5-yr olds	Born	Weaned			2-1/2 years	3-1/2 years	4-1/2 years	5-1/2 years
Angus Hereford	Hereford-X	44	37	24	11	94.4	81.1	April 1	95.3	873	1002	1034	1125
	Angus-X	46	44	27	10	93.4	89.4	April 1	93.2	870	972	1025	1039
	Average	90	81	51	21	93.9	85.3	April 1	94.2	871	987	1029	1082
Brahman	Hereford-X	26	24	13	9	87.3	78.6	April 7	98.3	961	1029	1069	1201
	Angus-X	17	17	12	5	96.3	88.5	April 2	99.3	940	1069	1129	1104
	Average	43	41	25	14	91.8	83.5	April 5	98.8	950	1049	1099	1153
Devon	Hereford-X	29	30	18	12	92.0	84.7	April 4	95.5	882	989	1039	1167
	Angus-X	28	28	16	11	93.1	83.2	March 29	95.0	907	995	1063	1107
	Average	57	58	34	23	92.6	83.9	April 1	95.3	895	992	1051	1137
Holstein	Hereford-X	25	22	12	5	96.6	87.0	March 31	98.6	949	1049	1065	1260
	Angus-X	20	20	7	2	100.0	87.2	April 1	90.6	940	1047	1198	1059
	Average	45	42	19	7	98.3	87.1	March 31	94.6	945	1048	1132	1159
Average all sire breeds	Hereford-X	124	113	67	37	92.6	82.8	April 3	96.9	916	1017	1052	1188
	Angus-X	111	109	62	28	96.2	87.1	April 1	94.6	914	1021	1104	1077
	Average	235	222	129	65	94.4	85.0	April 2	95.7	915	1019	1078	1133

^a Hereford-X denotes Hereford crosses and Angus-X denotes Angus crosses. Dams of these cows were sired by Hereford, Angus, Jersey, South Devon, Limousin, Simmental, and Charolais bulls.

^b Of females exposed to breeding and alive at fall palpation the previous year.

^c The average breeding period was 63 days by natural service to Red Poll bulls. Percent pregnant = number palpated as pregnant ÷ number palpated, and reflects the rebreeding performance or conception rate of cows which had calved at 2, 3, 4, or 5 years of age.

TABLE 12. ROMAN L. HRUSKA U.S. MEAT ANIMAL RESEARCH CENTER GERM PLASM EVALUATION PROGRAM
BREED GROUP MEANS FOR REPRODUCTION AND MATERNAL PERFORMANCE OF CROSSBRED COWS AT 2 THROUGH 5 YEARS OF AGE
CYCLE I, PHASE 3 - COWS BORN 1972-73-74

Breed group ^a	Number births	Calving diffi- culty ^b %	Calf crop		Birth weight lb	200 day weight			
			Born %	Weaned %		Per calf weaned lb	Ratio ^c %	Per cow exposed lb	Ratio ^c %
Hereford-Angus-X	243	20.0	94	85	80	427	100	364	100
Brangus-X	123	4.6	92	84	76	479	112	400	110
Devon-X	172	5.5	93	84	80	425	100	357	98
Holstein-X	113	16.0	98	87	86	490	115	427	117

^a Breed groups are 3-way crosses identified by breed of sire of the cow. An X denotes crosses of Hereford, Angus, Jersey, South Devon, Limousin, Simmental, and Charolais maternal grand sires on Hereford or Angus grand dams.

^b Includes calves requiring calf puller or C-section.

^c Ratio relative to Hereford-Angus crosses.

CYCLE II, PHASE 2

Foundation Cows. The foundation Hereford and Angus cows used in Cycle I were continued in Cycle II of the program. The cows calving in 1973 were 4 to 8 years of age and in 1974 were 4 to 9 years of age. As previously indicated, mature Brown Swiss and Red Poll cows were added to these herds for the 1972 and 1973 breeding season.

Sires. In Cycle II, 15 Hereford, 16 Angus, 16 Red Poll, 11 Brown Swiss, 11 Gelbvieh, 18 Maine Anjou, and 20 Chianina bulls were used during the 1972 and 1973 breeding seasons. The Hereford and Angus sires had also been used in Cycle I of the program, and the other bulls were sampled from commercial organizations. The Brown Swiss sires included four domestic bulls and seven bulls imported into Canada from Switzerland and Germany.

Matings. Cycle II, phase 2 yearling heifers were mated to Hereford, Angus, Brangus, and Santa Gertrudis by AI to produce their first calves as 2-year-olds in 1975 and 1976. The Cycle II, Phase 2 cows were bred by natural service to 3/4 Simmental bulls in 1975, 1976, and 1977 and to 7/8 Simmental bulls in 1978, 1979, and 1980.

2-Year-Olds. Data on calving difficulty, calf crop percentage, and birth and weaning weights of calves from 2-year-old dams (born in 1973-74) are presented in table 13 for cows out of Hereford and Angus dams. Data on rebreeding performance and size as 2-year-olds are given in table 14. Calving difficulty, calf mortality, calf birth weight, and 200-day weight were analyzed by least-squares procedures for unequal subclass numbers using a model that included the effects of breed of dam's sire, breed of dam's dam, breed of sire, year, sex, and two-way interactions. Unweighted means are presented for calf crop percentage, postpartum interval, and pregnancy rate.

3-, 4-, 5-, 6-, and 7-Year-Olds. Data on calving difficulty, calf crop percentage, and birth and weaning weights of calves from 3-, 4-, 5-, 6-, and 7-year-old dams (born in 1973-74) are presented in table 15 for cows out of Hereford and Angus dams. Data on rebreeding performance and size as 3-, 4-, 5-, 6-, and 7-year-olds are given in table 16.

Calving difficulty, calf mortality, calf birth weight, and preweaning growth were analyzed by least-squares procedures for unequal subclass numbers using a model that included the effects of breed of dam's sire, breed of dam's dam, breed of sire, year, sex, and two-way interactions. Calf crop percentage, pregnancy rate, cow weight, and cow height were analyzed by similar least-squares procedures, except that sex and interactions with sex were not included in the model.

Discussion

Results to-date on production of the F₁ females (as 2- through 7-year-olds) from Cycle II, Phase 2 of the program are presented in table 17. Calving difficulty has been lower for Brown Swiss and Chianina cross females than other breed groups, especially as 2-year-olds (table 13). Chianina cross females have

had relatively low calving difficulty considering the heavy birth weight of their calves. Differences between breed groups in calf crop percentage born and weaned have not been significant ($P > .05$). Brown Swiss cross and Gelbvieh cross females milked at the highest level and produced calves that were 12% heavier at 200 days than Hereford-Angus cross females. Maine-Anjou cross and Chianina cross females were comparable to Hereford-Angus crosses in milk production but produced calves that were 10% heavier in 200-day weight. Red Poll cross females were intermediate in the range among breed groups for milk production and 200-day weight of progeny. Calf weight was 12% to 15% greater for Brown Swiss, Gelbvieh, Maine-Anjou, and Chianina crosses than for Red Poll and Hereford-Angus crosses. Differences between breed groups in calving difficulty, calf crop percentage, and calf weights at birth and 200-days have decreased as cows have advanced in age. Thus, inference should not be drawn to breed groups in other cycles and phases of the program using deviations from Hereford-Angus crosses based on the preliminary data presented in this report.

TABLE 13. ROMAN L. HRUSKA U.S. MEAT ANIMAL RESEARCH CENTER GERM PLASM EVALUATION PROGRAM
CALVING DIFFICULTY, CALF CROP PERCENTAGE, CALF MORTALITY, BIRTH WEIGHT,
WEANING WEIGHT, AND WEANING WEIGHT RATIO OF CALVES FROM 2-YEAR-OLD COWS^a
CYCLE II, PHASE 2 - COWS BORN 1973-74

Breed of cow		Number calves born	Type of parturition, %				Calf crop, % ^c		Calf mortality, % ^d		Calf weight, lb ^e		
Sire	Dam		No diff. ^b	Calf puller	C-section	Abn. pre-sentation	Born	Weaned	Early	Late	Birth	200-day wt	200-day wt ratio ^f
Angus Hereford	Hereford	30	45.8	47.3	3.5	3.4	89.7	79.5	3.9	0.0	75.1	405	100.5
	Angus	31	46.0	50.6	0.3	3.0	75.5	59.2	24.4	0.6	75.9	402	99.8
	Average	61	45.9	49.0	1.9	3.2	81.8	68.2	14.2	0.0	75.5	403	100.0
Red Poll	Hereford	36	20.0	64.1	8.8	7.1	86.1	69.8	15.7	5.4	83.9	422	104.7
	Angus	43	33.4	52.3	8.1	6.2	81.1	62.3	14.3	8.1	80.2	423	105.0
	Average	79	26.7	58.2	8.5	6.7	83.3	65.6	15.0	6.7	82.1	423	105.0
Brown Swiss	Hereford	61	62.5	31.8	4.0	1.7	95.4	73.9	14.7	6.9	81.0	457	113.4
	Angus	55	65.8	29.0	1.9	3.3	88.9	77.8	13.8	0.0	81.4	466	115.6
	Average	116	64.1	30.4	2.9	2.5	92.2	75.8	14.3	3.0	81.2	461	114.4
Gelbvieh	Hereford	35	46.4	42.5	8.5	2.6	92.1	79.0	9.0	6.5	80.7	456	113.2
	Angus	36	42.9	43.9	11.0	2.2	90.0	77.5	4.8	11.3	84.7	471	116.9
	Average	71	44.7	43.2	9.8	2.4	91.0	78.2	6.9	8.9	82.7	463	114.9
Maine Anjou	Hereford	35	43.5	53.7	0.0	3.6	92.1	76.3	13.8	3.2	85.9	448	111.2
	Angus	46	42.4	49.4	4.8	3.4	93.8	81.3	12.7	3.1	86.4	436	108.2
	Average	81	43.0	51.6	2.0	3.5	93.0	79.1	13.2	3.2	86.1	442	109.5
Chianina	Hereford	35	55.9	38.7	1.7	3.7	80.0	68.9	6.1	7.4	84.8	438	108.7
	Angus	39	54.5	29.5	13.2	2.8	87.0	78.3	4.6	3.4	85.3	441	109.4
	Average	74	55.2	34.1	7.4	3.2	83.5	73.6	5.4	5.4	85.0	440	109.2
Average	Hereford	232	45.7	46.4	4.3	3.7	89.6	74.3	10.5	4.8	81.9	438	108.7
All sire breeds	Angus	250	47.5	42.4	6.6	3.5	86.0	72.6	12.4	4.3	82.3	440	109.2
	Average	482	46.6	44.4	5.4	3.6	87.0	73.4	11.5	4.5	82.1	439	108.9

^a Calves from these cows were sired by Hereford, Angus, Brangus, and Santa Gertrudis bulls (appendix table 4).

^b No assistance or minor hand assistance.

^c Of cows alive at calving; cows removed from experiment only for serious injury or by death.

^d Early mortality is within 72 hr of birth; late is from 72 hr after birth until weaning.

^e Adjusted to a steer basis. Least-squares adjustment factors for heifers were 8.1 lb for birth weight and 28 lb for 200-day weight.

^f Ratio computed relative to 403 lb average for Hereford and Angus sired dams.

TABLE 14. ROMAN L. HRUSKA U.S. MEAT ANIMAL RESEARCH CENTER GERM PLASM EVALUATION PROGRAM
CALVING DATE, REBREEDING PERFORMANCE, AND SIZE OF COWS CALVING AS 2-YEAR-OLDS
CYCLE II, PHASE 2 - COWS BORN 1973-74

Breed of cow		Number calving as 2-year-olds	Average calving date	Postpartum interval, days ^a	Percent pregnant ^b	Cow weight, lb 2-1/2 years	Hip height, in 2-1/2 years
Sire	Dam						
Angus Hereford	Hereford	30	March 26	72.3	85.7	939	47.1
	Angus	31	March 25	65.4	94.7	914	46.6
	Average	61	March 25	68.6	90.4	927	46.9
Red Poll	Hereford	36	March 27	68.4	83.8	879	47.6
	Angus	43	March 25	67.5	90.7	870	47.0
	Average	79	March 26	67.9	87.5	874	47.3
Brown Swiss	Hereford	61	March 27	73.0	90.3	935	49.3
	Angus	55	March 25	71.2	96.4	938	49.0
	Average	116	March 26	72.1	93.2	937	49.1
Fleischschaff	Hereford	35	March 27	68.2	97.1	978	49.5
	Angus	36	March 26	60.1	100.0	979	48.8
	Average	71	March 26	64.1	98.6	979	49.1
Maine Anjou	Hereford	35	March 27	69.5	94.3	1019	50.1
	Angus	46	March 25	70.7	91.3	1008	49.4
	Average	81	March 26	70.2	92.6	1013	49.8
Chianina	Hereford	35	April 2	74.1	88.9	1022	52.9
	Angus	39	March 24	78.2	90.0	1022	52.2
	Average	74	March 28	76.4	89.5	1022	52.6
Average all sire breeds	Hereford	232	March 28	71.0	90.0	962	49.4
	Angus	250	March 25	69.2	93.8	955	48.8
	Average	482	March 26	70.1	92.0	959	49.1

^a Interval from calving to first estrus.

^b Breeding period was 63 days by natural service to 3/4 Simmental bulls (appendix table 4). Percent pregnant = number palpated as pregnant ÷ number palpated, and only include cows that calved prior to breeding.

TABLE 15. ROMAN L. HRUSKA U.S. MEAT ANIMAL RESEARCH CENTER GERM PLASM EVALUATION PROGRAM
CALVING DIFFICULTY, CALF CROP PERCENTAGE, CALF MORTALITY, BIRTH WEIGHT,
WEANING WEIGHT, AND WEANING WEIGHT RATIO OF CALVES FROM 3-, 4-, 5-, 6- AND 7-YEAR-OLD COWS^a
CYCLE II, PHASE 2 - COWS BORN 1973-74

Breed of cow		Number calves born	Type of parturition, %				Calf crop, % ^c		Calf mortality, % ^d		Calf weight, lb ^e		
Sire	Dam		No diff. ^b	Calf puller	C- section	Abn. pre- sentation	Born	Weaned	Early	Late	Birth	200- day wt	200-day wt ratio ^f
Angus	Hereford	137	92.1	4.2	0.0	3.6	90.4	84.4	5.1	2.9	89.0	492	100.0
Hereford	Angus	197	84.0	13.6	0.5	1.9	93.7	89.4	2.6	2.5	90.3	492	100.0
	Average	334	88.1	8.9	0.3	2.7	92.1	86.9	3.8	2.7	89.7	492	100.0
Red Poll	Hereford	149	86.2	10.5	0.0	3.3	92.8	84.0	4.6	2.9	94.0	522	106.1
	Angus	187	92.2	5.3	0.0	2.4	89.5	80.1	5.7	1.5	89.1	514	104.5
	Average	336	89.2	7.9	0.0	2.9	91.2	82.1	5.2	2.2	91.5	518	105.3
Brown Swiss	Hereford	258	88.2	8.2	0.8	2.9	92.1	85.0	6.9	1.0	96.9	552	112.2
	Angus	247	93.9	3.1	0.4	2.6	94.2	88.8	3.9	2.3	92.3	551	112.0
	Average	505	91.0	5.6	0.6	2.8	93.2	86.9	5.4	1.7	94.6	551	112.0
Gelbvieh	Hereford	158	89.7	7.2	0.8	2.4	97.0	89.2	3.4	4.5	94.9	549	111.6
	Angus	171	93.3	4.7	0.5	1.5	95.0	87.5	8.1	1.3	89.5	546	111.0
	Average	329	91.5	6.0	0.6	1.9	96.0	88.4	5.7	2.9	92.2	547	111.2
Maine Anjou	Hereford	159	90.6	6.8	0.0	2.5	93.1	87.1	3.2	3.8	100.3	544	110.6
	Angus	189	92.4	6.2	0.0	1.5	93.3	87.4	2.5	3.7	97.6	533	108.3
	Average	348	91.5	6.5	0.0	2.0	93.2	87.3	2.9	3.8	99.0	539	109.6
Chianina	Hereford	171	95.1	2.9	1.1	0.9	95.3	90.2	1.5	3.2	100.8	543	110.4
	Angus	181	92.9	5.1	0.5	1.5	94.6	88.5	4.8	2.6	97.3	541	110.0
	Average	352	94.0	4.0	0.8	1.2	95.0	89.4	3.2	2.9	99.1	542	110.2
Average all sire breeds	Hereford	1032	90.3	6.6	0.5	2.6	93.5	86.7	4.1	3.1	96.0	534	108.6
	Angus	1172	91.5	6.3	0.3	1.9	93.4	87.0	4.6	2.3	92.7	530	107.7
	Average	2204	90.9	6.5	0.4	2.3	93.5	86.8	4.4	2.7	94.4	532	108.1

^a Calves from these cows were sired by 3/4 or 7/8 Simmental bulls (appendix table 4).

^b No assistance or minor hand assistance.

^c Of cows alive at calving; cows removed from experiment only for serious injury, being open two successive years or by death.

^d Early mortality is within 72 hr of birth; late is from 72 hr after birth until weaning.

^e Adjusted to a steer basis. Least-squares adjustment factors for heifers were 7.0 lb for birth weight and 32 lb for 200-day weight.

^f Ratio computed relative to 492 lb average for Hereford and Angus sired dams.

TABLE 16. ROMAN L. HRUSKA U.S. MEAT ANIMAL RESEARCH CENTER GERM PLASM EVALUATION PROGRAM
CALVING DATE, AND SIZE OF COWS CALVING AS 3-, 4-, 5-, 6-, AND 7-YEAR-OLD COWS
CYCLE II, PHASE 2 - COW BORN 1973-74

Breed of cow		Number of cows			Average calving date	Cow weight, lb		Cow hip height, in		Condition score ^a	
		5-yr olds	6-yr olds	7-yr olds		6-1/2 years	7-1/2 years	6-1/2 years	7-1/2 years	6-1/2 years	7-1/2 years
Sire	Dam										
Angus Hereford	Hereford	34	33	18	March 30	1215	1235	49.0	48.9	7.5	6.7
	Angus	48	46	26	April 2	1157	1164	48.3	48.3	7.2	6.4
	Average	82	79	44	March 31	1186	1200	48.7	48.6	7.3	6.5
Red Poll	Hereford	38	35	25	March 30	1131	1108	49.2	48.4	6.5	5.9
	Angus	48	46	29	March 30	1109	1123	48.8	48.6	6.5	5.9
	Average	86	81	54	March 30	1120	1115	49.0	48.5	6.5	5.9
Brown Swiss	Hereford	63	62	38	March 31	1190	1231	51.2	51.3	6.3	6.2
	Angus	59	58	38	March 29	1180	1198	50.6	50.3	6.3	5.9
	Average	122	120	76	March 30	1185	1215	50.9	50.8	6.3	6.1
Gelbvieh	Hereford	35	33	15	April 1	1247	1266	51.4	50.7	6.7	6.2
	Angus	39	38	17	March 31	1224	1244	50.5	50.1	6.5	6.5
	Average	74	71	32	April 1	1236	1255	51.0	50.4	6.6	6.4
Maine Anjou	Hereford	38	37	17	March 29	1323	1369	51.8	51.9	6.7	6.3
	Angus	46	43	26	March 30	1317	1340	51.1	50.5	6.8	6.5
	Average	84	80	43	March 30	1320	1355	51.4	51.2	6.7	6.4
Chianina	Hereford	42	40	28	April 1	1336	1386	54.9	55.2	6.2	6.4
	Angus	43	43	27	March 31	1311	1331	53.9	53.9	6.3	6.1
	Average	85	83	55	March 31	1324	1359	54.4	54.6	6.3	6.3
Average all sire breeds	Hereford	250	240	141	March 31	1240	1266	51.1	51.1	6.7	6.3
	Angus	283	274	163	March 31	1216	1233	50.5	50.3	6.6	6.2
	Average	533	514	304	March 31	1228	1250	50.9	50.7	6.6	6.3

^a Condition is scored on a scale of 1 to 9; 1 = thin, emaciated; 5 = average; 9 = very fat.

TABLE 17. ROMAN L. HRUSKA U.S. MEAT ANIMAL RESEARCH CENTER GERM PLASM EVALUATION PROGRAM
BREED GROUP MEANS FOR REPRODUCTION AND MATERNAL PERFORMANCE OF F₁ COWS AT 2 THROUGH 7 YEARS OF AGE
CYCLE II, PHASE 2 - COWS BORN 1973-74

Breed group ^a	Number births	Calving diffi- culty ^b %	Calf crop		Birth weight lb	Milk prod ^c lb	200-day weight			
			Born %	Weaned %			Per calf weaned lb	Ratio ^d %	Per cow exposed lb	Ratio ^d %
Hereford-Angus-X	395	17	90	84	87	6.2	476	100	400	100
Red Poll-X	415	19	90	79	90	7.6	501	105	398	100
Brown Swiss-X	621	11	93	85	92	8.4	535	112	455	114
Gelbvieh-X	400	15	95	87	91	8.4	532	112	461	115
Maine-Anjou-X	429	15	93	86	97	6.5	521	110	449	112
Chianina-X	426	11	93	87	97	6.2	523	110	455	114

^a Breed groups are identified by sire breed. An X denotes crosses out of Hereford and Angus dams.

^b Includes calves requiring calf puller or C-section.

^c Average of three 12-hour milk production measures on a sample of 36 cows per breed group (18 per year) at 3 years of age.

^d Ratio relative to Hereford-Angus crosses.

CYCLE II, PHASE 3

Sires. The mating plans to produce Cycle II, Phase 3, calves are presented in appendix table 4. There were 13 Hereford, 14 Angus, 13 Santa Gertrudis, and 14 Brangus sires used by AI to produce the two calf crops (1975-76). These sires were sampled from commercial organizations, with the Hereford and Angus sires being the same as used in other cycles and phases of the program. Females resulting from cleanup matings to Hereford and Angus sires were also included in the study.

2-Year-Olds. Data on calving difficulty, calf crop percentage, and birth and weaning weights of calves from 2-year-old dams (born in 1975-76) are presented in table 18 according to breed of cows sire. Data for corresponding breed groups on rebreeding performance and size as 2-year-olds are given in table 19.

Calving difficulty, calf mortality, calf birth weight, and preweaning growth were analyzed by least-squares procedures for unequal subclass numbers using a model that included the effects of breed of dam's sire, breed of dam's dam, breed of sire, year, sex, and two-way interactions. Calf crop percentage, pregnancy rate, cow weight, and cow height were analyzed by similar least-squares procedures, except that sex and interactions with sex were deleted from the model.

3-, 4-, and 5-year-olds. Data on calving difficulty, calf crop percentage, and birth and weaning weights of calves from 3-, 4-, and 5-year old dams (born in 1975-76) are given in table 20 according to breed of cows sire. Data for corresponding breed groups on rebreeding performance and size as 2-year-olds are given in table 21. The models for least-squares analyses were exactly the same as for calving and rebreeding traits as 2-year-olds except that effects of year-age of cow was included instead of effects of just year.

Discussion

Results on production of the 3-way cross females (as 2- through 5-year-olds) from Cycle II, Phase 3 of the program are summarized in table 22. Calving difficulty was less in Santa Gertrudis crosses than in Brangus and Hereford-Angus crosses because of less calving difficulty as 2-year-olds (table 18). Differences between breed groups for percentage calf crop born, percentage calf crop weaned, birth weight, and 200-day weight per cow exposed were not significant ($P > .05$). Calves out of Brangus and Santa Gertrudis crosses were 5% and 6%, respectively, heavier at 200 days than calves out of Hereford-Angus crosses.

TABLE 18. ROMAN L. HRUSKA U.S. MEAT ANIMAL RESEARCH CENTER GERM PLASM EVALUATION PROGRAM
CALVING DIFFICULTY, CALF CROP PERCENTAGE, CALF MORTALITY, BIRTH WEIGHT, WEANING
WEIGHT, AND WEANING WEIGHT RATIO OF CALVES FROM 2-YEAR-OLD COWS^a
CYCLE II, PHASE 3 - COWS BORN IN 1975-76

Breed of cow		Number calves born	Type of parturition, %				Calf crop, % ^d		Calf mortality, % ^e		Calf weight, lb ^f		
Sire	Dam ^b		No diff. ^c	Calf puller	C- section	Abn. pre- sentation	Born	Weaned	Early	Late	Birth	day wt	200-day wt ratio ^g
Angus Hereford	Hereford	35	61.5	28.9	8.7	2.7	87.1	76.4	4.9	3.6	76.9	428	98.2
	Angus-X	40	36.7	54.7	4.7	4.6	90.6	73.7	20.2	2.7	76.4	445	102.1
	Average	75	49.1	41.8	6.7	3.6	88.8	75.0	12.6	3.1	76.7	436	100.0
Brangus	Hereford-X	31	60.0	28.4	9.4	2.2	92.7	90.1	3.2	1.2	77.8	475	108.9
	Angus-X	24	42.2	38.3	4.7	14.8	86.0	74.2	6.7	7.3	79.9	475	108.9
	Average	55	51.1	33.3	7.1	8.5	89.4	82.2	4.9	4.2	78.9	475	108.9
Santa Gertrudis	Hereford-X	21	78.0	19.4	0.0	4.2	100.9	92.9	9.1	0.0	75.3	485	111.2
	Angus-X	19	69.5	10.7	13.6	6.1	99.4	75.5	17.6	0.0	81.7	487	111.7
	Average	40	73.8	15.0	6.0	5.2	97.3	84.2	13.4	0.0	78.5	486	111.5
Average all sire breeds	Hereford-X	87	66.5	25.6	6.0	3.0	93.6	86.5	5.7	1.6	76.7	463	106.1
	Angus-X	83	49.5	34.6	7.7	8.5	92.0	74.5	14.8	3.3	79.3	469	107.6
	Average	170	58.0	30.1	6.8	5.8	92.8	80.5	10.3	2.5	78.0	466	106.8

^a Calves from these cows were sired by Shorthorn bulls.

^b Hereford-X denotes Hereford crosses and Angus-X denotes Angus crosses.

^c No assistance or minor hand assistance.

^d Of cows palpated at end of previous breeding season.

^e Early mortality is within 72 hr of birth; late is from 72 hr after birth until weaning.

^f Adjusted to a steer basis. Least-squares adjustment factors for heifers were 5.9 lb for birth weight and 28 lb for 200-day weight.

^g Ratio computed relative to 436 lb average for Hereford and Angus.

TABLE 19. ROMAN L. HRUSKA U.S. MEAT ANIMAL RESEARCH CENTER GERM PLASM EVALUATION PROGRAM
CALVING DATE, REBREEDING PERFORMANCE, AND SIZE OF COWS CALVING AS 2-YEAR-OLDS
CYCLE II, PHASE 3 - COWS BORN IN 1975-76

Breed of cow		Number calving as 2-year-olds	Average calving date	Percent pregnant ^b	Cow weight, lb 2-1/2 years	Condition score ^c 2-1/2 years
Sire	Dam ^a					
Angus	Hereford-X	35	March 11	96.9	1006	6.3
Hereford	Angus-X	40	March 16	87.2	1000	6.6
	Average	75	March 13	92.1	1003	6.4
Brangus	Hereford-X	31	March 13	92.5	1016	5.9
	Angus-X	24	March 16	91.6	1023	6.0
	Average	55	March 15	92.0	1020	5.9
Santa Gertrudis	Hereford-X	21	March 10	81.5	1027	6.3
	Angus-X	19	March 10	85.6	1040	5.9
	Average	40	March 10	83.6	1033	6.1
Average	Hereford-X	87	March 11	90.3	1016	6.2
all sire	Angus-X	83	March 14	88.1	1021	6.2
breeds	Average	170	March 13	89.2	1018	6.2

^a Hereford-X denotes Hereford crosses and Angus-X denotes Angus crosses.

^b Breeding period was 63 days by natural service to 7/8 Simmental bulls. Percent pregnant = number palpated as pregnant ÷ number palpated, and only includes cows that calved prior to breeding.

^c Condition is scored on a scale of 1 to 9; 1 = thin, emaciated; 5 = average; 9 = very fat.

TABLE 20. ROMAN L. HRUSKA U.S. MEAT ANIMAL RESEARCH CENTER GERM PLASM EVALUATION PROGRAM
CALVING DIFFICULTY, CALF CROP PERCENTAGE, CALF MORTALITY, BIRTH WEIGHT, WEANING
WEIGHT, AND WEANING WEIGHT RATIO OF CALVES FROM 3-, 4-, AND 5-YEAR-OLD COWS^a
CYCLE II, PHASE 3 - COWS BORN 1975-76

Breed of cow		Number calves born	Type of parturition, %				Calf crop, % ^d		Calf mortality, % ^e		Calf weight, lb ^f		
Sire	Dam ^b		No diff. ^c	Calf puller	C- section	Abn. pre- sentation	Born	Weaned	Early	Late	Birth	200- day wt	200-day wt ratio ^g
Angus Hereford	Hereford-X	66	87.4	7.0	0.2	5.4	93.7	80.7	13.4	1.1	85.1	512	101.0
	Angus-X	76	89.7	5.5	1.2	3.5	86.0	82.1	7.8	0.0	87.6	502	99.0
	Average	142	88.6	6.3	0.7	4.5	89.8	81.4	10.6	0.0	86.3	507	100.0
Brangus	Hereford-X	60	90.1	9.0	0.2	0.6	84.6	78.8	0.0	2.3	88.8	520	102.6
	Angus-X	46	88.1	8.9	0.2	2.8	88.2	78.8	2.3	3.8	89.7	528	104.1
	Average	106	89.1	9.0	0.2	1.7	86.4	78.8	0.2	3.1	89.3	524	103.4
Santa Gertrudis	Hereford-X	37	89.8	7.2	0.2	2.9	83.0	68.0	2.6	6.8	88.7	524	103.4
	Angus-X	34	100.0	0.0	0.7	0.0	83.0	67.3	0.0	11.2	88.4	534	105.3
	Average	71	98.8	3.6	0.4	0.8	83.0	67.6	1.0	9.0	88.5	529	104.3
Average all sire breeds	Hereford-X	163	89.1	7.7	0.2	3.0	87.1	75.8	4.7	3.4	87.5	519	102.4
	Angus-X	156	95.2	2.4	0.7	1.7	85.7	76.1	3.1	4.5	88.6	521	102.8
	Average	319	92.2	5.1	0.4	2.3	86.4	76.0	3.9	4.0	88.0	520	102.6

^a Calves from these cows were sired by 7/8 Simmental bulls.

^b Hereford-X denotes Hereford crosses and Angus-X denotes Angus crosses.

^c No assistance or minor hand assistance.

^d Of cows palpated at end of previous breeding season.

^e Early mortality is within 72 hr of birth; late is from 72 hr after birth until weaning.

^f Adjusted to a steer basis. Least-squares adjustment factors for heifers were 7.2 for birth weight and 33 lb for 200-day weight.

^g Ratio computed relative to 507 lb average for Hereford and Angus sired dams.

TABLE 21. ROMAN L. HRUSKA U.S. MEAT ANIMAL RESEARCH CENTER GERM PLASM EVALUATION PROGRAM
CALVING DATE, REBREEDING PERFORMANCE, AND SIZE OF COWS CALVING AS 3- AND 4-YEAR-OLDS
CYCLE II, PHASE 3 - COWS BORN IN 1975-76

Breed of cow		Number calving as		Average calving date	Percent pregnant ^b	Cow weight, lb		Condition score ^c	
Sire	Dam ^a	3-yr olds	4-yr olds			3-1/2 years	4-1/2 years	3-1/2 years	4-1/2 years
Angus Hereford	Hereford-X	28	11	March 26	96.1	1103	1220	6.6	5.9
	Angus-X	33	13	April 4	88.4	1073	1101	6.3	6.5
	Average	61	24	March 30	92.2	1088	1161	6.4	6.2
Brangus	Hereford-X	30	10	March 27	89.9	1083	1185	5.9	6.0
	Angus-X	23	6	April 6	95.2	1987	1201	5.7	5.9
	Average-X	53	16	April 1	92.5	1085	1193	5.8	5.9
Santa Gertrudis	Hereford-X	18	5	March 29	84.6	1117	1293	5.8	6.9
	Angus-X	15	4	March 30	87.2	1120	1218	5.2	6.0
	Average	33	9	March 30	85.9	1119	1255	5.5	6.5
Average all sire breeds	Hereford-X	76	26	March 27	90.2	1101	1232	6.1	6.3
	Angus-X	71	23	April 3	90.2	1093	1173	5.7	6.2
	Average	147	49	March 31	90.2	1097	1203	5.9	6.2

^a Hereford-X denotes Hereford crosses and Angus-X denotes Angus crosses.

^b Breeding period was 63 days by natural service to 7/8 Simmental bulls. Percent pregnant = number palpated as pregnant ÷ number palpated, and only includes cows that calved prior to breeding.

^c Condition is scored on a scale of 1 to 9; 1 = thin, emaciated; 5 = average; 9 = very fat.

TABLE 22. ROMAN L. HRUSKA U.S. MEAT ANIMAL RESEARCH CENTER GERM PLASM EVALUATION PROGRAM
BREED GROUP MEANS FOR REPRODUCTION AND MATERNAL PERFORMANCE OF CROSSBRED COWS AT 2 THROUGH 5 YEARS OF AGE
CYCLE II, PHASE 3 - COWS BORN 1975-76

Breed group ^a	Number births	Calving diffi- culty ^b %	Calf crop		Birth weight lb	200 day weight			
			Born %	Weaned %		Per calf weaned lb	Ratio ^c %	Per cow exposed lb	Ratio ^c %
Hereford-Angus-X	217	19	90	80	84	487	100	388	100
Brangus-X	261	18	87	80	86	510	105	406	105
Santa Gertrudis-X	111	9	87	72	86	517	106	372	96

^a Breed groups are 3-way crosses identified by breed of sire of the cow. An X denotes crosses of Hereford, Angus, Red Poll, Brown Swiss, Gelbvieh, Maine Anjou, or Chianina maternal grand sires on Hereford or Angus maternal grand dams.

^b Includes calves requiring calf puller or C-section.

^c Ratio relative to Hereford-Angus crosses.

CYCLE III, PHASE 2

Cows. The foundation Hereford and Angus cows used to produce Phase 2 calves in Cycles I and II were continued in Cycle III of the program (appendix table 5). The two calf crops in Cycle III, Phase 2, were produced in 1975 and 1976.

Sires. There were 13 Hereford, 14 Angus, 17 Brahman, 6 Sahiwal, 9 Pinzgauer, and 7 Tarentaise sires used during the 1974 and 1975 breeding seasons. The Hereford and Angus bulls had also been used in Cycle I and Cycle II of the program, and the Brahman bulls were sampled from commercial AI organizations or purebred Brahman herds. Semen was available from only two Sahiwal bulls (imported from Australia) and one Tarentaise bull for the 1974 breeding season. Semen was available on four additional Sahiwal bulls and six additional Tarentaise bulls for the 1975 breeding season to produce the Cycle III, Phase 2, calf crop in 1976.

A sample of about 32 heifers from each of the Angus-Hereford, Hereford-Angus, Brahman-Hereford, Brahman-Angus, Sahiwal-Hereford, Sahiwal-Angus, Pinzgauer-Hereford, and Pinzgauer-Angus breed groups were transferred to the U.S. Department of Agriculture Station at Brooksville, Fla., for an interregional study cooperative with the Florida Agricultural Experiment Station to evaluate genotype-environment interactions involving maternal traits. These heifers and those remaining at the Roman L. Hruska U.S. Meat Animal Research Center were mated by natural service to bulls sampled from the same population of Red Poll to produce their first calf crop and to 7/8 Simmental bulls to produce their second through fourth calf crops.

2-Year-Olds. Data on calving difficulty, percentage calf crop, and birth and weaning weight of progeny from 2-year-old Cycle III, Phase 2, females (born in 1975 and 1976) are presented in table 23. Data on rebreeding performance and size as 2-year-olds are given for the corresponding breed group in table 24. These data were analyzed by least-squares procedures using a model that included effects of breed of sire, breed of dam, year, and their two-way interactions. Sex of calf and two-way interactions with sex were deleted from models for calf crop percentage, rebreeding performance, and cow size.

3-, 4-, and 5-year-olds. Data on calving difficulty, percentage calf crop, and birth and weaning weights of calves from 3-, 4-, and 5-year old Cycle III, Phase 2, females (born in 1975-76) are presented in table 25. Data on rebreeding performance and size as 4- and 5-year olds are given for the corresponding breed group in table 26. The Cycle III, Phase 2, females were bred as 2- and 3-year-olds to 7/8 Simmental sires. These data were analyzed by least-squares procedures using a model that included effects of breed of dam's sire, breed of dam's dam, year-age of cow, and two-way interactions. Effects of sex of calf and two-way interaction of breed of dam's sire, breed of dam's dam, and year-age with sex were also included in models for calving difficulty and birth and weaning weight of progeny.

Discussion

Results to-date on production of the F₁ females (as 2- through 5-year-olds)

from Cycle III, Phase 2 of the program are summarized in table 27. Sahiwal and Brahman cross females experienced significantly less calving difficulty than the other breed groups in Cycle III. This difference in calving difficulty in favor of Sahiwal and Brahman crosses was of greatest magnitude for the first parturition as 2-year-olds (table 23). Differences in calf crop born and weaned have not been significant ($P > .05$). Birth weight of calves out of Pinzgauer and Tarentaise crosses have been heavier than calves out of Hereford-Angus crosses while birth weight of calves out of Sahiwal and Brahman crosses have been lighter than Hereford-Angus crosses. Differences in milk production between Tarentaise, Pinzgauer, Sahiwal, and Brahman cross females were not large; all exceeded Hereford-Angus cross females. Brahman crosses exceeded all crosses in 200-day weight weaned per calf and per cow exposed to breeding. Weaning weights of progeny out of Pinzgauer, Tarentaise, and Sahiwal cross females were 7% to 11% heavier per calf weaned and 10% to 16% heavier per cow exposed to breeding than progeny out of Hereford-Angus cross females (as 2-through 5-year-olds). Differences between breed groups in calving difficulty, calf crop percentage, and calf weights at birth and 200-days have decreased as cows have advanced in age and as the number of records have increased. Thus, inference should not be drawn to breed groups in other cycles and phases of the program using deviations from Hereford-Angus crosses based on preliminary data presented in this report.

TABLE 23. ROMAN L. HRUSKA U.S. MEAT ANIMAL RESEARCH CENTER GERM PLASM EVALUATION PROGRAM
CALVING DIFFICULTY, CALF CROP PERCENTAGE, CALF MORTALITY, BIRTH WEIGHT,
WEANING WEIGHT, AND WEANING WEIGHT RATIO OF CALVES FROM 2-YEAR-OLD COWS^a
CYCLE III, PHASE 2 - COWS BORN 1975-76

Breed of cow		Number calves born	Type of parturition, %				Calf crop, % ^c		Calf mortality, % ^d		Calf weight, lb ^e		
Sire	Dam		No diff. ^b	Calf puller	C- section	Abn. pre- sensation	Born	Weaned	Early	Late	Birth	200- day wt	200-day wt ratio ^f
Angus Hereford	Hereford	21	60.7	30.9	1.5	7.0	67.1	66.8	1.2	0.0	75.0	398	101.0
	Angus	60	34.8	50.7	11.4	3.1	83.8	70.8	14.2	1.4	74.1	389	98.7
	Average	81	47.8	40.8	6.4	5.0	75.5	68.8	7.7	0.4	74.6	394	100.0
Pinzgauer	Hereford	40	40.2	47.1	3.1	9.6	90.3	74.8	10.6	4.0	83.4	436	110.7
	Angus	58	52.7	39.6	3.9	3.8	80.0	74.0	4.8	0.8	78.9	425	107.9
	Average	98	46.5	43.3	3.5	6.7	85.1	74.4	7.7	2.4	81.1	431	109.4
Tarentaise	Hereford	31	53.9	39.3	0.0	6.9	94.0	84.8	9.9	0.0	79.8	456	115.7
	Angus	40	58.5	35.3	4.6	1.7	77.0	64.3	16.4	0.0	74.8	437	110.9
	Average	71	56.2	37.3	2.3	4.3	85.5	74.6	13.2	0.0	77.3	446	113.2
Brahman	Hereford	35	86.9	7.7	0.4	5.0	83.5	76.9	8.2	0.8	77.1	483	122.6
	Angus	55	87.1	11.0	2.7	0.0	89.5	80.7	6.7	2.4	75.4	490	124.4
	Average	90	87.0	9.4	1.5	2.1	86.5	78.8	7.4	1.6	76.2	486	123.4
Sahiwal	Hereford	30	89.3	10.4	0.4	0.0	93.6	90.2	3.9	0.0	68.5	453	115.0
	Angus	51	88.3	8.4	0.0	3.2	93.1	85.9	5.9	1.5	64.3	439	111.4
	Average	81	88.8	9.4	0.2	1.6	93.4	88.0	4.9	0.7	66.4	446	113.2
Average all sire breeds	Hereford	157	66.2	27.1	1.1	5.7	85.7	78.7	6.8	0.8	76.8	445	112.9
	Angus	264	64.3	29.0	4.5	2.2	84.7	75.1	9.6	1.2	73.5	436	110.7
	Average	421	65.2	28.0	2.8	3.9	85.2	76.9	8.2	1.0	75.1	441	111.9

^a Calves from these cows were sired by Red Poll bulls.

^b No assistance or minor hand assistance.

^c Of cows alive at calving; cows removed from experiment only for serious injury, by death or being open two consecutive seasons.

^d Early mortality is within 72 hr of birth; late is from 72 hr after birth until weaning.

^e Adjusted to a steer basis. Least-squares adjustment factors for heifers were 4.1 lb for birth weight and 28 lb for 200-day weight.

^f Ratio computed relative to 394 lb average for Hereford and Angus sired dams.

TABLE 24. ROMAN L. HRUSKA U.S. MEAT ANIMAL RESEARCH CENTER GERM PLASM EVALUATION PROGRAM
CALVING DATE, REBREEDING PERFORMANCE, AND SIZE OF COWS CALVING AS 2-YEAR-OLDS
CYCLE III, PHASE 2 - COWS BORN IN 1975-76

Breed of cow		Number calving as 2-year-olds	Average calving date ^a	Percent pregnant ^{a,h}	Cow weight, lb 2-1/2 years	Hip height, in 2-1/2 years
Sire	Dam					
Angus	Hereford	21	March 11	98.0	976	47.9
Hereford	Angus	60	March 15	87.8	965	47.2
	Average	81	March 13	92.9	971	47.5
Pinzgauer	Hereford	40	March 16	90.6	980	49.4
	Angus	58	March 14	90.0	964	48.5
	Average	98	March 15	90.3	972	49.0
Tarentaise	Hereford	31	March 17	87.8	974	49.4
	Angus	40	March 16	83.2	950	48.4
	Average	71	March 16	85.5	962	48.9
Brahman	Hereford	35	March 20	95.6	1013	51.3
	Angus	55	March 16	93.3	1012	51.0
	Average	90	March 18	94.4	1012	51.1
Sahiwal	Hereford	30	March 17	96.9	915	49.8
	Angus	51	March 18	100.0	875	48.6
	Average	81	March 17	98.6	895	49.2
Average	Hereford	157	March 16	93.8	971	49.6
all sire	Angus	264	March 16	90.9	953	48.7
breeds	Average	421	March 16	92.3	962	49.1

^a Includes cows calving at 2 years of age.

^b Breeding period was 63 days by natural service to 7/8 Simmental bulls. Percent pregnant = number palpated as pregnant ÷ number palpated, and only includes cows that calved prior to breeding.

TABLE 25. ROMAN L. HRUSKA U.S. MEAT ANIMAL RESEARCH CENTER GERM PLASM EVALUATION PROGRAM
CALVING DIFFICULTY, CALF CROP PERCENTAGE, CALF MORTALITY, BIRTH WEIGHT,
WEANING WEIGHT, AND WEANING WEIGHT RATIO OF CALVES FROM 3-, 4-, AND 5-YEAR-OLD COWS^a
CYCLE III, PHASE 2 - COWS BORN 1975-76

Breed of cow		Number calves born	Type of parturition, %				Calf crop, % ^c		Calf mortality, % ^d		Calf weight, lb ^e		
Sire	Dam		No diff. ^b	Calf puller	C-section	Abn. pre-sentation	Born	Weaned	Early	Late	Birth	200-day wt	200-day wt ratio ^f
Angus	Hereford	77	90.4	7.6	0.1	2.0	95.7	84.4	7.5	2.2	85.7	473	101.5
Hereford	Angus	177	90.1	8.2	0.0	1.8	92.6	83.9	7.0	1.9	84.3	460	98.7
	Average	254	90.2	7.9	0.0	1.9	94.2	84.2	7.2	2.0	85.0	466	100.0
Pinzgauer	Hereford	101	88.5	10.1	0.0	1.4	92.7	82.8	6.1	3.4	89.9	499	107.1
	Angus	153	93.4	5.2	0.5	0.8	93.4	86.9	6.5	0.7	87.9	496	106.4
	Average	254	91.0	7.6	0.3	1.1	93.1	84.8	6.3	2.0	88.9	497	106.7
Tarentaise	Hereford	69	95.8	4.1	0.0	0.1	89.9	82.1	0.2	4.1	88.8	521	111.8
	Angus	99	94.6	2.2	1.2	2.1	88.9	83.6	5.5	0.2	83.1	507	108.8
	Average	168	95.2	3.2	0.6	1.1	89.4	82.9	2.9	2.1	86.0	514	110.3
Brahman	Hereford	106	98.7	0.3	0.1	0.9	94.8	86.5	4.1	3.1	81.7	534	114.6
	Angus	144	99.6	0.0	0.0	0.5	95.1	84.3	5.7	4.9	79.1	530	113.7
	Average	250	99.1	0.1	0.0	0.7	95.0	85.4	4.9	4.0	80.4	532	114.2
Sahiwal	Hereford	69	97.3	2.7	0.0	0.0	91.9	82.6	4.7	3.0	76.3	503	107.9
	Angus	118	99.1	0.7	0.0	0.2	95.8	86.2	2.8	5.5	72.0	496	106.4
	Average	187	98.2	1.7	0.0	0.1	93.8	84.4	3.8	4.3	74.1	499	107.1
Average all sire breeds	Hereford	422	94.2	5.0	0.0	0.9	93.0	83.7	4.5	3.1	84.5	506	108.6
	Angus	691	95.4	3.2	0.3	1.1	93.2	85.0	5.5	2.6	81.3	498	106.9
	Average	1113	94.8	4.1	0.2	1.0	93.1	85.0	2.9	1.0	82.9	502	107.7

^a Calves from these cows were sired by 7/8 Simmental bulls.

^b No assistance or minor hand assistance.

^c Of cows alive at calving; cows removed from experiment only for serious injury, by death or being open two consecutive seasons.

^d Early mortality is within 72 hr of birth; late is from 72 hr after birth until weaning.

^e Adjusted to a steer basis. Least-squares adjustment factors for heifers were 5.0 lb for birth weight and 28 lb for 200-day weight.

^f Ratio computed relative to 466 lb average for Hereford and Angus sired dams.

TABLE 26. ROMAN L. HRUSKA U.S. MEAT ANIMAL RESEARCH CENTER GERM PLASM EVALUATION PROGRAM
CALVING DATE, REBREEDING PERFORMANCE, AND SIZE OF COWS CALVING AS 4-, AND 5-YEAR-OLD COWS
CYCLE III, PHASE 2 - COW BORN 1975-76

Breed of cow		Number calving as		Average calving date ^a	Cow weight, lb		Cow hip height, in		Condition score ^b	
Sire	Dam	4-yr olds	5-yr olds		4-1/2 years	5-1/2 years	4-1/2 years	5-1/2 years	4-1/2 years	5-1/2 years
Angus Hereford	Hereford	30	21	March 28	1167	1239	48.9	49.1	7.2	7.3
	Angus	68	50	April 1	1130	1153	48.3	48.2	7.0	7.0
	Average	98	71	March 30	1149	1196	48.6	48.6	7.1	7.1
Pinzgauer	Hereford	39	28	March 28	1158	1260	50.4	51.5	6.4	6.6
	Angus	58	42	March 31	1140	1201	49.6	50.6	6.5	6.2
	Average	97	70	March 29	1149	1230	50.0	51.1	6.5	6.4
Tarentaise	Hereford	30	16	March 30	1153	1221	50.4	50.3	6.6	6.7
	Angus	47	17	April 1	1110	1157	49.3	49.7	6.4	6.4
	Average	77	33	March 31	1131	1189	49.9	50.0	6.5	6.6
Brahman	Hereford	42	29	March 30	1195	1270	52.3	52.8	6.8	7.3
	Angus	58	39	March 31	1219	1258	51.8	52.1	6.9	6.8
	Average	100	68	March 30	1207	1264	52.0	52.4	6.9	7.1
Sahiwal	Hereford	32	13	March 29	1093	1222	50.8	52.2	6.3	7.2
	Angus	52	17	March 28	1051	1058	49.5	49.6	6.3	6.6
	Average	84	30	March 29	1072	1140	50.1	50.9	6.3	6.9
Average all sire breeds	Hereford	173	107	March 29	1153	1242	50.5	51.1	6.7	7.0
	Angus	283	165	March 31	1130	1165	49.7	50.0	6.7	6.6
	Average	456	272	March 30	1142	1204	50.1	50.6	6.7	6.8

^a Includes cows calving at 3, 4, and 5 years of age.

^b Condition is scored on a scale of 1 to 9; 1 = thin, emaciated; 5 = average; 9 = very fat.

TABLE 27. ROMAN L. HRUSKA U.S. MEAT ANIMAL RESEARCH CENTER GERM PLASM EVALUATION PROGRAM
BREED GROUP MEANS FOR REPRODUCTION AND MATERNAL PERFORMANCE OF F₁ COWS AT 2 THROUGH 5 YEARS OF AGE
CYCLE III, PHASE 2 - COWS BORN 1975-76

Breed group ^a	Number births	Calving diffi- culty ^b %	Calf crop		Birth weight lb	Milk prod ^c lb	200-day weight			
			Born %	Weaned %			Per calf weaned lb	Ratio ^d %	Per cow exposed lb	Ratio ^d %
Hereford-Angus-X	335	19	89	80	82	5.4	445	100	358	100
Tarentaise-X	239	14	88	81	84	7.2	495	111	399	112
Pinzgauer-X	352	19	91	82	87	7.3	478	107	393	110
Sahiwal-X	268	4	94	85	72	7.8	484	109	413	116
Brahman-X	340	3	93	84	79	8.4	519	116	434	121

^a Breed groups are identified by sire breed. An X denotes crosses out of Hereford and Angus dams.

^b Includes calves requiring calf puller or C-section.

^c Average of three 12-hour milk production measures on a sample of 36 cows per breed group (18 per year) at 3 years of age.

^d Ratio relative to Hereford-Angus^a crosses.

APPENDIX

TABLE 1. MATING PLANS TO PRODUCE CYCLE I, PHASE 2, CALVES

1969, 1970, 1971 Breeding Seasons

Dam Breeds ^a	Sire Breeds						
	Hereford ^b	Angus ^b	Jersey	South Devon	Limousin	Simmental	Charolais
Hereford	X	X	X	X	X	X	X
Angus	X	X	X	X	X	X	X

^a The cows were 1, 2, 3, and 4-year-olds in 1969; 1, 2, 3, 4, and 5-year-olds in 1970; and 2, 3, 4, 5, and 6-year-olds in 1971.

APPENDIX

TABLE 2. MATING PLANS TO PRODUCE CYCLE II, PHASE 2, CALVES

1972 and 1973 Breeding Seasons

Dam Breeds ^a	Sire Breeds						
	Hereford ^b	Angus ^b	Red Poll	Brown Swiss	Gelbvieh	Maine Anjou	Chianina
Hereford ^c	X	X	X	X	X	X	X
Angus ^c	X	X	X	X	X	X	X
Red Poll	X	X	X	X			
Brown Swiss	X	X	X	X			

^a The cows were 3, 4, 5, 6, and 7-year-olds in 1972; and 3, 4, 5, 6, 7, and 8-year-olds in 1973.

^b Sample of same Hereford and Angus sires used in Cycle I, 1969, 1970, and 1971 breeding seasons.

^c Cows used for GPE Cycle I, 1969, 1970, and 1971 breeding seasons.

APPENDIX

TABLE 3. MATING PLANS TO PRODUCE CYCLE I, PHASE 3 CALVES^a

1971 - 1978 Breeding Seasons

	Sire Breeds										
	First Calf Crop ^b					Second Calf Crop ^c					Subsequent Calf Crops ^d
Breed Group	Here-ford ^e	Angus ^e	Brahman	Devon	Hol-stein	Here-ford ^e	Angus ^e	Gelb-vieh	Maine Anjou	Chia-nina	Brown Swiss
H x H		X					X				X
A x A	X					X					X
A x H			X	X	X			X	X	X	X
H x A			X	X	X			X	X	X	X
J x H		X	X	X	X		X	X	X	X	X
J x A	X		X	X	X	X		X	X	X	X
SD x H		X	X	X	X		X	X	X	X	X
SD x A	X		X	X	X	X		X	X	X	X
L x H		X	X	X	X		X	X	X	X	X
L x A	X		X	X	X	X		X	X	X	X
S x H		X	X	X	X		X	X	X	X	X
S x A	X		X	X	X	X		X	X	X	X
C x H		X	X	X	X		X	X	X	X	X
C x A	X		X	X	X	X		X	X	X	X

^a Females of each breed group distributed equally among cells marked "X" for each calf crop.^b Each group of heifers bred as yearlings to produce one calf crop as 2-year-olds by these breeds in 1972, 1973 and 1974.^c Each group of cows bred as 2-year-olds to produce one calf crop as 3-year-olds by these breeds in 1973, 1974 and 1975.^d Each group of cows bred to produce at least four calf crops by this breed from 1974 through 1979.^e Sample of same sires used in Cycle I, 1969-70-71 breeding seasons.

APPENDIX

TABLE 4. MATING PLANS TO PRODUCE CYCLE II, PHASE 3, CALVES^a

1974-1981 Breeding Season

Female Breeding Groups	First Calf Crop ^b				Subsequent Calf Crops ^c
	Hereford ^d	Angus ^d	Branqus	Santa Gertrudis	Simmental
Hereford		X	X	X	X
Angus	X		X	X	X
Red Poll	X	X			X
Brown Swiss	X	X			X
H x A & Recip.			X	X	X
H x R.P. & Recip.		X	X	X	X
H x B.S. & Recip.		X	X	X	X
A x R.P. & Recip.	X		X	X	X
A x B.S. & Recip.	X		X	X	X
Gelbvieh x Hereford			X	X	X
Gelbvieh x Angus	X		X	X	X
Maine Anjou x Hereford		X	X	X	X
Maine Anjou x Angus	X		X	X	X
Chianina x Hereford		X	X	X	X
Chianina x Angus	X		X	X	X

^a Females of each breed group distributed equally among the cells marked "X" for each calf crop.

^b Each group of heifers bred as yearlings to produce one calf crop as 2-year-olds by these breeds in 1975 and 1976.

^c Each group of cows mated to produce at least three calf crops by 3/4 or 7/8 Simmental bulls in 1976 through 1982.

^d Sample of same Hereford and Angus sires used in Cycle I, Phase, 1969, 1970, and 1971 breeding seasons.

APPENDIX

TABLE 5. MATING PLANS TO PRODUCE CYCLE III, PHASE 2, CALVES^a

1974 and 1975 Breeding Seasons

Dam Breeds ^b	Sire Breeds					
	Hereford ^c	Angus ^c	Pinzgauer	Tarentaise	Brahman	Sahiwal
Hereford		X	X	X	X	X
Angus	X		X	X	X	X

^a Approximately 256 heifers (32 of each breed group, except Tarentaise) were transferred to Brooksville, Fla.

^b Cows used for GPE Cycle I, Phase 1, 1970 and 1971 breeding seasons.

^c Sample of same Hereford and Angus sires used in Cycle I, Phase I, 1969, 1970, and 1971 breeding seasons.

APPENDIX

TABLE 6. MATING PLANS TO PRODUCE CYCLE I, PHASE 3, CALVES^a
1971-1978 Breeding Seasons

Breed Group	Sire Breeds	
	First Calf Crop ^b	Subsequent Calf Crops ^c
	Red Poll	Simmental
A x H	X	X
H x A	X	X
P x H	X	X
P x A	X	X
T x H	X	X
T x A	X	X
Br x H	X	X
Br x A	X	X
Sw x H	X	X
Sw x A	X	X

^a Females of each breed group distributed equally among cells marked "X" for each calf crop.

^b Each group of heifers bred as yearlings to produce one calf crop as 2-year-olds by Red Poll bulls in 1977 and 1978.

^c Each group of cows bred to produce at least four calf crops by Simmental bulls from 1978 through 1982.